In the department of astronomy and cosmical physics, Dr. W. E. Wilson exhibited a bolometer arranged to record solar radiation. It consists of two blackened coiled platinum wires, on one of which the light of the sun is allowed to fall through an opening in the metal box in which both are enclosed. The Rev. A. L. Cortie has examined in detail the Greenwich records of sun-spots and faculæ, and the diurnal ranges of the declination magnet, for the years 1899-1901, and finds that there is not sufficient accordance to support the statement sometimes made that sun-spots cause magnetic storms. He considers the two are correlated effects of some common cause still to be found.

The committee for investigating the upper atmosphere by means of kites gave a report of flights made from their station near Oban during July and August. The average height reached was about 3500 feet, and the average rate of decrease of temperature upwards about 3°·5 F. per 1000 feet.

Dr. Shaw, in his communication on radiation in meteorology, pointed out that radiation or absorption of heat by a cloud would result in motion of the cloud downwards or upwards. This motion would produce in its turn a heating or cooling of the cloud opposed to the initial change, and a much more careful and extended study of the radiation from clouds than had hitherto been attempted was necessary before several of the problems connected with cloud motion could be solved. He suggested several ways in which observers with simple instruments could help toward the solution of these problems.

Prof. Milne, in presenting the report of the Seismological Committee, stated that each of the recent West Indian eruptions had been preceded by sudden readjustments of the strata in the neighbourhood, which left their traces on the earthquake-recording instruments. This may, after further investigation, lead to a method of predicting eruptions.

Dr. Roberts exhibited photographs of nebulæ illustrating the nebular theory of the evolution of star systems, from cloudy nebulæ, through the spiral stage, to star clusters.

Mr. Hinks opened a discussion on the nebula surrounding Nova Persei by showing that some of the phenomena exhibited by the nebula might be due to its being ring-shaped. Photographs exhibited by Dr. Roberts did not, however, appear to support this view, and there seems little hope of coming to any definite conclusion as to the nature of the nebula until more information as to its appearance is available. C. H. LEES.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE total number of communications brought before Section C at Belfast was thirty-five. None of them can be said to have been of really great importance, but they were for the most part records of good work. The Committee on Life-zones in the Carboniferous Rocks sent in an admirable report of careful and systematic fossil-collecting. The Committees on the Underground Waters of N.W. Yorkshire and on Erratic Blocks were also able to show excellent work, and Prof. W. W. Watts, as usual, brought a good series of photographs which had been collected by his committee during the past year. Proceedings opened on Thursday, September 11, with the president's address, which has already been printed in our columns. It was followed by a lecture on the geology of the country around Belfast by Prof. Grenville A. J. Cole. On the morning of Sept. 15 Prof. Cole gave a second lecture, on the geological structure of Ireland; both lectures were illustrated by lantern slides and were listened to with close attention by large audiences. A considerable number of the papers naturally dealt with the geology of Ireland, and it may be convenient to notice them first and then to mention some of the other communications in geographical order. A proof-sheet of the Drift edition of the geological map of Ireland was exhibited by Mr. Teall, the director of the Survey. He explained that it was printed in colour instead of being hand-coloured, and was consequently clearer and would cost much less than the hand-coloured maps now issued by the Survey.

The post-Glacial deposits of the Belfast district were described in a most interesting paper by Mr. R. Lloyd Praeger. A peat bed, representing an old land surface, is found 20 feet below low water at Belfast, but between tides at other places in the district. In it remains of the Irish elk have been found, and a little above it there is some 12 feet of blue clay, the upper part of which contains *Thracia convexa* and other shells, indicating a warmer climate than the fauna now living in the Irish Sea and a depth of five to ten fathoms, whilst in the lower part of the clay, *Scrobicularia piperata* and fossils of a shore type are found.

Mr. P. F. Kendall read a paper by Madame Christen giving an account of the recent work of the Belfast Field Club. The members have made a careful study of the drifts of the district. They have, for example, proved the transport of the Rhyolite of Tardree to the north as well as in other directions. Attention was also drawn to the wide dispersal through the district of blocks from Ailsa Craig, and it was stated that these blocks are practically always found associated with marine shells. The committee appointed to explore Irish caves was able to show excellent work in the caves of Keishcorran Mountain, a mass of Carboniferous Limestone fifteen miles south of Sligo. In the Coffey Cave, bones of the Arctic lemming had been found in considerable numbers. This, the report states, is the first record of its existence as a former inhabitant of Ireland. Excavations in an extensive series of caves at Edenvale, county Clare, were described. Remains of bear and of the Irish elk were recorded, as well as human implements, ornaments, &c., and Mr. R. J. Ussher, who read the report, said that he hoped for important evidence of the state of prehistoric Ireland from further exploration.

Mr. Joseph Wright announced his discovery of large numbers of marine Foraminifera in Boulder-clay from various places in Ireland and also from England, Wales, Scotland, the Isle of Man and Canada. He more especially dealt with the Boulder-clay of Knock Glen, near Belfast. From it he had obtained seventy-nine species, and he suggested a considerable depression of the area at the time of its deposition. This led to an animated discussion, Prof. Boyd Dawkins supporting the author's view and Messrs. Lamplugh and Kendall contending for a transport of the clay to its present position by land ice.

A paper by Mr. R. Clark dealt with the Silurians of north-east Ireland. The author described some new fossil localities and gave lists of the species found.

Mr. G. Barrow read a paper on the prolongation of the Highland Border rocks into county Tyrone. The author referred to the Jasper and green-rock series, which he had found between Blairgowrie and Stonehaven (*Q.J.G.S.* vol. lvii. p. 328), and explained that he believed it to correspond with a series found by Mr. Peach near Omagh. He thought these rocks were intermediate in age between the Highland rocks, which he looked upon as Archæan, and a newer series, the Pomroy rocks, of Silurian age.

An interesting discussion followed the reading of this paper.

Mr. McHenry agreed that in Ireland there are three series:—(1) An old series, which he thought was probably metamorphosed Llandeilo and Bala; (2) the green rocks; and (3) the Pomroy rocks, which are mapped Lower Silurian, but contain Devonian and Wenlock fossils with a few survivors of Bala type. The conglomerates of this third series contain pebbles of the green rocks. He agreed that the line between the green rocks and the older series was a great thrust which in his opinion affected the Old Red Sandstone. He had followed it south-west to Castlebar and Clew Bay into Clare Island.

Mr. Teall agreed that this line of disturbance in Ireland should be classed with that which the author had worked out in Forfarshire, but he thought further evidence was required as to the age of the rocks. Dr. Matley, Prof. Cole, Prof. J. F. Blake and Mr. Cunningham-Craig also spoke. In reply, the author said he was sure of the order of succession, but not of the precise age of the rocks.

A list of 113 minerals known to occur in Ireland was contributed by Mr. H. J. Seymour. He explained that it was but of a preliminary character and that he had only included species which he was satisfied really have been found in the country.

Passing to Scottish geology, a paper of very great interest was sent in by Mr. Kynaston and was read by Mr. Teall. The author described a series of volcanic rocks in the district extending from Glen Coe to the Black Mount. The lower part consists of some 1500 feet of basic andesites with sandstone, shale and conglomerate at the base. Above these andesites are agglomerates and breccias capped by some 700 feet of hornblende andesite. Messrs. Peach and Tait have discovered plant remains in a bed of black shale associated with these lavas which enable the author to fix their age as Lower Old Red Sandstone; that is, they are of the same date as the great volcanic series of Lorn.

The author then showed that the granite of Ben Cruachan

s newer than these volcanic series, thus solving a question of considerable interest. From this it follows that the boulders of granite found in the basement conglomerate of the volcanic series are not derived from the granite of the district, but must have come from some other area.

Two papers were sent in by Dr. W. Mackie. The first dealt with the conditions under which manganese dioxide has been precipitated in the Elgin sandstone. The second gave the results of a series of determinations of the soluble chlorides and sulphates in the same sandstone, made with a view to test the theory that from such an examination it is possible to determine the character of the waters of the basin of deposit of sedimentary rocks. The result was of a negative character, and the author believes it is not safe to infer that the soluble salts of a deposit represent the salts of the original waters of the basin of deposition.

English geology occupied a very small part of the time of the Section. Mr. Horace B. Woodward sent an interesting note relating to the Eocenes. A section on a new railway between Axminster and Lyme Regis shows a good example of Bagshot strata near Combe Pyne Hill which serves to connect the beds of that age at Bournemouth with the deposit at Bovey Tracey in Devon. This last is now admitted to be of Bagshot age. It used to be called Miocene, but Mr. Starkie Gardner has long contended that it is equivalent to the Bournemouth Series.

A paper on the fossil flora of the Cumberland Coalfield was read by Mr. E. A. Newell Arber, who described plants from both the Whitehaven sandstone and the Coal-measures.

Mr. P. F. Kendall dealt with the Vale of Eden. He believed that he could show from the relative position of the Permian breccias or Brockrams that a movement of the Pennine faults had taken place in Permian times.

There was one paper relating to Wales. It was by Mr. W. G. Fernsides, who described some new faunas which he had obtained at Pen Morfa, near Tremadoc. He described a zone with species of high Lingula Flag type 30 feet below the Lower Tremadoc. Some 30 feet above the horizon of Ramsay's Lower Tremadoc fossils, he had found a continuous zone of Dictyonema, and had mapped its outcrop for more than five miles. Finally, some 400 feet above the Dictyonema, he had found a Shineton fauna with a number of Swedish forms and some new species.

Passing now to papers dealing with localities outside the British Isles, we may mention a paper by Dr. R. H. Traquair on fishes of the Lower Devonian roofing slate of Gemünden in Germany. They belong to the class with mailed bodies and are there associated with a fauna thoroughly marine in character, a point of considerable interest. The author showed some beautiful photographs of the fishes and of starfishes, crinoids, trilobites, corals, &c., from the slates.

Indian geology was dealt with in an interesting note by Prof. H. G. Seeley. He said that hitherto there has been no evidence of Cretaceous strata in the Salt Range of the north of India, but he was now able to bring forward an account of a series of species found by Mr. E. G. Fraser on the shoulder of Sekasar. They are of the type or age of the Upper Greensand.

Two papers dealt with Victoria, Australia. Mr. James Stirling gave some notes on a new geological map of the colony, and Dr. Smith Woodward sent an account of some observations on a new Lower Carboniferous fish-fauna from the Broken River. Attention was first drawn to these Broken River fossils some twelve years ago, and the late Sir Frederick M'Coy described them as a mixture of Devonian and Carboniferous forms. This Dr. Woodward now shows to have been a mistake; he considers them typically and essentially Carboniferous. Dr. Traquair said that he had seen the collection and could corroborate all the statements in the paper. Palæontologists might now congratulate themselves that the myth which alleged the existence of fishes of Lower and Upper Devonian and Lower Carboniferous types in the same bed had been exploded.

With regard to America, the only contribution was a paper by Dr. H. Woodward on the Middle Cambrian Trilobites of Mount Stephen, British Columbia.

Most of the Palæontological papers have already been noticed, but an interesting note on the tusks and skull of *Mastolon angustidens*, by Dr. C. W. Andrews, deserves mention.

Prof. J. Joly brought forward a suggestive paper on the viscous fusion of rock-forming minerals, which gave rise to an interesting discussion in which Mr. Teall, Prof. Grenville Cole and Dr. Johnston-Lavis took part.

Prof. J. F. Blake read a paper on the original form of sedimentary deposits. He observed that during the continuance of constant physical conditions, the seaward boundary of river-brought deposits will be a marked line. Such a line has been called an escarpment and the edge of the continental plateau, but the author believed it to be the limit of terrigenous deposits in bulk. He also considered that limestones are most likely to form deposits of lenticular shape with the long axis parallel to the shore, and when they are found to give place to shales we should infer that we are approaching a river or other source of sediment.

In conclusion, we may mention that a series of excursions to places of geological interest was arranged by Messrs. G. W. Lamplugh, J. St. J. Phillips and H. J. Seymour, and were much appreciated by the geologists present at the meeting.

CARBON AND PLANTS.[1]

IN a paper recently laid before the Royal Society, dealing with the physical processes which regulate the entry of atmospheric carbon dioxide into the leaves of plants,[2] the authors incidentally described a series of experiments relating to the rate of absorption of dilute gaseous carbon dioxide by surfaces of solutions of caustic alkali, when air containing definite small amounts of this gas is drawn over the liquid. Contrary to what might be expected from the perfect absorbing nature of the solution, and the known laws of gaseous diffusion, the amount of CO_2 absorbed by unit area of the liquid surface in unit time ceases sensibly to increase when a comparatively low velocity of the moving air current has been reached. This, however, only holds good when the proportion of CO_2 in the air stream is maintained quite constant, any slight variation in the amount at once affecting the rate of absorption. On investigation, it was found that for dilutions of carbon dioxide lying between 0·6 part and 6 parts per 10,000 of air, the rate of absorption of the carbon dioxide *is strictly proportional to its partial pressure*.

In determining the rates of gaseous diffusion of atmospheric carbon dioxide through multiperforate diaphragms extended over chambers containing perfect absorbents, the same relations between partial pressure of the gas and its absorption were found to hold good; under these conditions the amount of carbon dioxide passing through the diaphragm in a given time is also directly proportional to the density of that gas in the moving stream of air which flows over the outer surface of the diaphragm.

But this latter case exactly defines the physical conditions under which atmospheric carbon dioxide enters the tissue of a living leaf, the multiperforate diaphragm being represented by the cuticle and epidermis, pierced with numerous stomata, and the inner absorbing chamber by the intercellular spaces of the parenchyma, bounded by the chlorophyll-containing cells in which the process of photosynthesis goes on (*loc. cit.*).

The authors have now found, by enclosing the living leaves in glass cases through which air containing known proportions of CO_2 is passed, that a living leaf is really able, within certain limits, to respond to increased amounts of carbon dioxide in the air surrounding it, in such a manner as to indicate an approximate proportionality between the photosynthetic work it can accomplish and the partial pressure the gas exercises in the air bathing the leaf surface.

The following experiment may be selected from several, in illustration:—

Experiment I.—In this case, comparative experiments were made on two successive days in August, 1898, with two similar leaves, A and B of *Helianthus annuus* whilst still attached to the plant. These were exposed to the strong diffused light of a clear northern sky under as nearly as possible identical conditions, with the exception of the composition of the air drawn through the cases.

Over leaf A was drawn normal air containing 2·8 parts per 10,000 of CO_2, whilst the air passing over leaf B contained 25·53 parts CO_2 per 10,000.

[1] Abridged from a paper on "The Influence of Varying Amounts of Carbon Dioxide in the Air on the Photosynthetic Process of Leaves and on the Mode of Growth of Plants," by Dr. Horace T. Brown, F.R.S., and Mr. F. Escombe. Read before the Royal Society on May 29.

[2] *Phil. Trans.*, B. 1900, vol. cxciii. p. 278.